Università degli Studi di Pavia

Dipartimento di Ingegneria Civile e Architettura

in collaboration with

Centro di Simulazione Numerica Avanzata – CeSNA
Istituto Universitario di Studi Superiori

SEMINAR

Transient Interaction of Acoustic Shock Waves with a Fluid-Filled Functionally Graded Hollow Elastic Sphere

A detailed study is undertaken to analyze the interaction of plane progressive transient pressure waves with an isotropic, homogeneous, and fluid-filled spherical elastic shell of arbitrary wall thickness which is submerged in an unbounded non-viscous compressible fluids. The formulation is based on the general three dimensional equations of linear elasticity and the wave equation for the internal/external domains. The Laplace transform with respect to the time coordinate is invoked, and the classical method of separation of variables is used to obtain the transformed solutions in the form of partial-wave expansions in terms of Legendre polynomials. Detailed numerical results for the transient and vibratory responses of water-submerged steel shells of selected wall thickness parameters with various internal fluid loadings under an exponential wave excitation are presented. Many of the interesting dynamic features in the transient shell–shock interaction such as shock transparency, shell-radiated negative pressure waves, focusing, the specularly-reflected, the lowest symmetric S0- and anti-symmetric A0-Lamb waves, as well as appearance of the Franz's creeping waves are examined using appropriate 2D images. Likelihood of cavitation is addressed and regions proned to cavitation are identified. Moreover, the effects of internal fluid impedance in addition to shell wall thickness on the dynamic stress concentrations induced within the shell are analyzed. Limiting cases are considered and fair agreements with well-known solutions are established. Also, an exact analysis is carried out to study interaction of a time-domain plane-progressive sound field with a radially inhomogeneous thick-walled elastic isotropic spherical shell suspended in and filled with compressible ideal fluid mediums. Using the laminated approximation model is adopted to deal with the assumed power law variation of the constituents' volume fractions across the thickness of the inhomogeneous sphere. Numerical example is given for elastic spherical shell containing a FGM thick-walled spherical shell ceramic/metal rich material compositional gradient profiles, subjected to an incident plane shock wave with wideband/narrowband Gaussian incident shock loadings are presented and discussed.

Eng. Ako Bahari

Monday, January 21, Aula MS1, 10.00

Dipartimento di Ingegneria Civile e Architettura

Via Ferrata,3 – Pavia

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